ANTHROPOGENIC EFFECTS ON DIGESTIVE GLAND OF *PINNA NOBILIS* USING OXIDATIVE STRESS BIOMARKERS

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Abstract
The fan mussel *Pinna nobilis* L. is the largest endemic bivalve in the Mediterranean Sea under strict protection. The aim was to determine the effects of anthropogenic activity on antioxidant and oxidative stress biomarkers in digestive gland of *P. nobilis*. Antioxidant enzyme activities and protein oxidation were significantly increased in mussels sampled in the impacted area. The anthropogenic activities induced a situation of oxidative stress in *P. nobilis*, resulting in an antioxidant response and in an increased protein oxidation.

Keywords: Ecotoxicology, Bio-accumulation, Bio-indicators, Endemism, Balearic Islands

Aquatic organisms are exposed to anthropogenic contaminants that may strongly affect their performance and survival. The exposure of bivalves to pollutants results in oxidative stress throughout the formation of reactive oxygen species (ROS), which can produce deleterious effects on biomolecules and cell damage [1]. The measurement of the antioxidant response and/or the presence of oxidative damage are potential biomarkers to evidence the effects associated to contaminants and also to eutrophication in marine organisms. The fan mussel *Pinna nobilis* L. is the largest endemic bivalve in the Mediterranean Sea under strict protection. The population of *P. nobilis* has been greatly reduced during the last decades as a result of recreational and commercial fishing for food, the use of its shell for decorative purposes, and incidental killing by trawling and anchoring. Moreover, in a previous study we reported that the presence of *Lophocladia lallemandii* colonising *P. nobilis* induces a biological stress and oxidative damage to the fan mussel [2]. Nowadays, *P. nobilis* is under strict protection and all forms of deliberate capture or killing them are prohibited (Council directive 92/43/EEC). The aim of the present work was to determine the antioxidant enzyme response and markers of oxidative damage in digestive gland of *P. nobilis* growing under anthropogenic pressure. *P. nobilis* (20 individuals) were collected from two locations along Mallorca waters during May-June 2011 attending to different degree of human impact. The first station was located in a marine protected area off Cabrera Archipelago National Park (Western Mediterranean), located 9 km southeast of Mallorca Island and was considered as a clean non-polluted area. The second set of stations because of the low *P. nobilis* densities, the difficulties to find large specimens and in order to minimize the impact in their populations were collected in two sites (Magalluf and Port d'Andratx) with similar characteristics and individuals were considered as human impacted. Digestive glands from each specimen were immediately dissected out on board and frozen with liquid nitrogen. Enzymatic activities of catalase, glutathione peroxidase and glutathione reductase were significantly increased in the impacted area ($p<0.05$), whereas no differences were reported in superoxide dismutase activity (Figure 1). Catalase protein levels determined by western blot were significantly higher in the exposed group ($p<0.05$). Malondialdehyde as marker of lipid peroxidation reported no significant differences, whereas a significant increase in protein oxidation was evidenced in the impacted area ($p<0.05$). In conclusion, the anthropogenic activities induce an oxidative stress situation in digestive gland of *P. nobilis* evidenced by an increased antioxidant enzyme activities and protein oxidation.

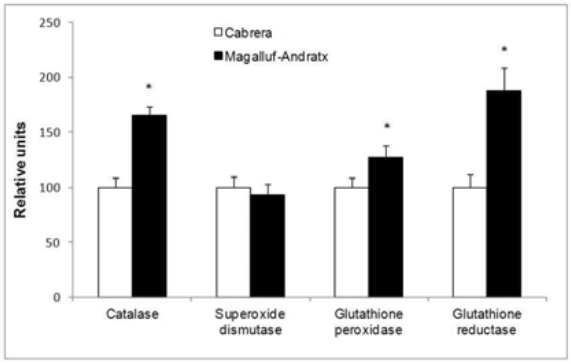

Fig. 1. Antioxidant enzyme activities in digestive gland of *Pinna nobilis* from a clean area (Cabrera) and a polluted area (Magalluf-Andratx). (*) Significant differences analysed with one-way ANOVA. $P<0.05$ was considered statistically significant. Values are expressed as mean ± S.E.M.

References

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